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Remarks

In response to the Office Action dated January 16, 2002, Applicant respectfully requests reexamination and reconsideration of the outstanding rejections of the claims in view of the amendments above and remarks that follow. Applicant has amended claims 1-3, 9-11, and 17-19. No new matter has been added by these amendments. Claims 1-24 are pending.

I. Objections to Drawings

Applicant has submitted a proposed drawing amendment with the changes indicated in red. Applicant will submit formal drawings incorporating this amendment upon receipt of a Notice of Allowance.

II. Section 112 Rejections

The Examiner rejected claims 9-16 under 35 U.S.C. §112 because "the computer procedure" lacked proper antecedent basis. Applicant has amended claim 9 in accordance with the Examiner's suggestion, thereby obviating this rejection.

III. Section 101 Rejections

The Examiner rejected claims 17-24 under 35 U.S.C. §101 as being directed to non-statutory subject matter.

Applicant respectfully traverses. The Patent Office and the Federal Circuit have long agreed "that computer programs embodied in a tangible medium, such as floppy diskettes, are patentable subject matter under 35 U.S.C. 101" *In re Beauregard*, 35 USPQ2d 1383, 1384 (Fed. Cir. 1995). Applicant notes that this standard only requires that the media tangibly embody the program, not the computer, and respectively asserts that the phrase "signal-bearing media bearing the optimizer" satisfies this standard. Applicant also notes that this assertion is

consistent with the Patent Office practice in a large number of issued patents. *E.g.*, U.S. Patent Nos. 6243860, US6317804, 6212633, 6192165, 6041400, and 6029176.

IV. Section 103 Rejections

The Examiner rejected claims 1-4, 9-12, and 17-20 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No 5,768,595 to Gillies ("Gillies") in view of U.S. Patent No 5,740,443 to Carini ("Carini"). The Examiner also indicated that claims 5-8, 13-16, and 21-24 would be allowable if rewritten in independent form.

A. Claim 1

Applicant respectfully submits that claim 1, as amended, is not made obvious by the combination of Gillies and Carini because: (i) neither reference discloses "making at least one inlining decision using the site register-pressure data during a second compilation" and; (ii) even if the combination disclosed the claimed invention, the references teach away from the suggested combination.

(i) Neither reference discloses "making at least one inlining decision using the site register-pressure data during a second compilation."

The invention in claim 1, as amended, is directed at a method for optimizing a computer program comprising a child procedure and a parent procedure using inlining techniques. One problem that can arise from these techniques is excessive register pressure. The present invention overcomes these problems by compiling the source-code twice; one to collect site register-pressure data from the execution; and a second time to make at least one inlining decision using the site register-pressure data.

Gillies, in contrast, is directed at an optimizing compiler that controls register usage by identifying procedures that are rarely or never called. *Gillies, col. 2, lines 50-65.* Giles

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identifies the target procedures by collecting summary information for each procedure. *Gillies, col. 4, lines 5-10*. This information can include "register pressure/coloring (usage) information." Unlike the present invention, however, Gillies does not use site register pressure data. It only collects its profile information at the procedure level. Furthermore, because the system in Gillies is directed at identifying seldom used child procedures, it would not be interested in collecting site register pressure data. Once the system in Gillies determines that a child procedure is "seldom used," it simply ignores that procedure's register pressure during recompilation of any parent procedures. *Giles, col. 2, lines 35-45*.

Carini also fails to disclose "making at least one inlining decision using the site register-pressure data during a second compilation." Instead, Carini discloses an automatic inlining method that makes decisions based on a cost function. The inputs to the cost function include measurements of the size of the procedure, complexity, number of calls, and number of I/O calls for each procedure; the size of the region containing the call; the loop nesting level of the call; the number of conditionals along the path to the call; and whether or not any of the parameters of the call are used in loop bounds, array bounds, or conditionals of the called procedure. *Carini, col. 7, line 65 - col. 8, line 7*. Like Gillies, however, Carini fails to disclose the use of site register pressure data.

(ii) Even if the combination disclosed the claimed invention, the references teach away from the suggested combination.

The Federal Circuit has held that references can only be combined if there is some suggestion or incentive to do so. *In re Fine*, 5 USPQ2d 1596 (Fed. Cir. 1988). Art that teaches away from the combination is strong evidence of nonobviousness. *Id.* In this case, Carini is directed at "a long felt need for a call-site specific selective automatic inlining method which does not rely on profiling information." *Carini, col. 5, lines 60-65; see also Col. 6, lines 10-15* ("It is a futher object of the present invention to provide an automatic inlining method which

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provides performance equivalent to that obtained by user directed inlining . . . but which does not rely on profiling information"). Because Carini teaches away from using the profile information in Gillies, Applicant respectfully submits that there is no motivation to make the suggested combination.

For at least these reasons, Applicant respectfully submits that claim 1 is not made obvious by the suggested combination.

B. Claims 9 and 17

Claim 9, as amended, requires "making at least one inlining decision using the site register-pressure data during a second compilation." Claim 17, as amended, similarly requires an optimizer that "makes at least one inlining decision using the site register-pressure data during a second compilation." Accordingly, for at least the reasons discussed with respect to claim 1, Applicant respectfully submits that claims 9 and 17 are not made obvious by the suggested combination.

C. Claims 2-8, 10-16, and 18-24

Applicant has made minor amendments to claims 2-3, 8-9, and 18-19 to provide proper antecedent basis in view of the changes to base claims 1, 9, and 17.

Claims 2-8, 10-16, and 18-24 are dependent on claims 1, 9, and 17, respectively, and include all of their limitations. Accordingly, claims 2-8, 10-16, and 18-24 are not made obvious by the suggested combination if claims 1, 9, and 17 are not made obvious by the suggested combination.


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IV. Conclusion

It is to be understood that Applicant, by amending the claims, does not acquiesce to the Examiner's characterizations of the art of record or of Applicant's subject matter recited in the pending claims. Further, Applicant is not acquiescing to the Examiner's statements as to the applicability of the prior art of record to the pending claims by filing the instant responsive amendment.

In view of the above amendments and remarks, Applicant submits that this application is in condition for allowance and respectfully requests reconsideration and withdrawal of the rejections and objections. Allowance of all claims remaining in this application is respectfully requested. The Examiner is urged to call the undersigned at the below-listed telephone number if, in the Examiner's opinion, such a phone conference would expedite or aid in the prosecution of this application.

Respectfully submitted,

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Version with Marking to Show Changes

1 (Amended). A method for optimizing a computer program comprising a child procedure and a parent procedure, wherein the parent procedure comprises at least one statement that invokes the child procedure, wherein the method comprises:

 saving site register-pressure data from the execution of a first compilation; and
 making at least one inlining decision using the site register-pressure data during a second compilation.

2 (Amended). The method of claim 1, further comprising: [wherein the register-pressure data further comprises:]

saving a maximum register-pressure occurring in each procedure in the computer program;
 and
 making the at least one inlining decision using the maximum register-pressure data.

3 (Amended). The method of claim 2, wherein the site register-pressure data [further] comprises:

 [a site register-pressure comprising] a register pressure at each call site in the computer program that is a potential inlining candidate.

4 (Unchanged). The method of claim 1, wherein the making step further comprises:
 inlining the child procedure of the computer program into the parent procedure, in place of the statement that invokes the child procedure.

5 (Unchanged). The method of claim 3, wherein the making step further comprises:

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when deciding whether to inline the child procedure into the parent procedure, determining whether a sum of the maximum register-pressure and the site register-pressure exceeds a number of available registers.

6 (Unchanged). The method of claim 5, further comprising:

when the determining step is true, refraining from inlining the child procedure into the parent procedure.

7 (Unchanged). The method of claim 5, further comprising:

when the determining step is false, inlining the child procedure into the parent procedure in place of the statement that invokes the child procedure.

8 (Unchanged). The method of claim 7, further comprising:

setting the maximum register-pressure of the parent procedure to be a maximum of its existing value or the sum of the maximum register-pressure of the child procedure and the site register-pressure.

9 (Amended). A computer system for compiling a computer program including a child procedure and a parent procedure which includes one or more statements that invoke the child procedure, into a machine-readable representation, the computer system comprising:

an optimizer that optimizes the computer [procedure] program into an optimized representation, the optimizer saving site register-pressure data from the execution of a first compilation, and making at least one inlining decision using the site register-pressure data during a second compilation; and

a machine-readable code generator that generates a machine-readable representation of the computer procedure from the optimized representation.

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10 (Amended). The computer system of claim 9, wherein the optimizer further: [register-pressure data further comprises:]

saves a maximum register-pressure occurring in each procedure in the computer program;
and

makes the at least one inlining decision using the maximum register pressure data.

11 (Amended). The computer system of claim 10, wherein the site register-pressure data [further] comprises:

[a site register-pressure comprising] a register pressure at each call site in the computer program that is a potential inlining candidate.

12 (Unchanged). The computer system of claim 9, wherein the optimizer further comprises:

inlining the child procedure of the computer program into the parent procedure, in place of the statement that invokes the child procedure.

13 (Unchanged). The computer system of claim 11, wherein the optimizer further comprises:

when deciding whether to inline the child procedure into the parent procedure, determining whether a sum of the maximum register-pressure and the site register-pressure exceeds a number of available registers.

14 (Unchanged). The computer system of claim 13, wherein the optimizer further comprises:

when the determining step is true, refraining from inlining the child procedure into the parent procedure.

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15 (Unchanged). The computer system of claim 13, wherein the optimizer further comprises:

when the determining step is false, inlining the child procedure into the parent procedure in place of the statement that invokes the child procedure.

16 (Unchanged). The computer system of claim 15, wherein the optimizer further comprises:

setting the maximum register-pressure of the parent procedure to be a maximum of its existing value or the sum of the maximum register-pressure of the child procedure and the site register-pressure.

17 (Amended). A program product for optimizing a computer program that includes a child procedure and a parent procedure that comprises at least one statement that invokes the child procedure, comprising:

an optimizer that saves site register-pressure data from the execution of a first compilation, and

makes at least one inlining decision using the site register-pressure data during a second compilation; and

signal-bearing media bearing the optimizer.

18 (Amended). The program product of claim 17, wherein the optimizer further: [register-pressure data further comprises:]

saves a maximum register-pressure occurring in each procedure in the computer program; and

makes the at least one inlining decision using the maximum register-pressure data.

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19 (Amended). The program product of claim 18, wherein the site register-pressure data [further] comprises:

[a site register-pressure comprising] a register pressure at each call site in the computer program that is a potential inlining candidate.

20 (Unchanged). The program product of claim 17, wherein the optimizer further:
inlines the child procedure of the computer program into the parent procedure, in place of the statement that invokes the child procedure.

21 (Unchanged). The program product of claim 19, wherein the optimizer further:
when deciding whether to inline the child procedure into the parent procedure, determines whether a sum of the maximum register-pressure and the site register-pressure exceeds a number of available registers.

22 (Unchanged). The program product of claim 21, wherein the optimizer further:
when the determining step is true, refrains from inlining the child procedure into the parent procedure.

23 (Unchanged). The program product of claim 21, wherein the optimizer further:
when the determining step is false, inlines the child procedure into the parent procedure in place of the statement that invokes the child procedure.

24 (Unchanged). The program product of claim 23, wherein the optimizer further:
sets the maximum register-pressure of the parent procedure to be a maximum of its existing value or the sum of the maximum register-pressure of the child procedure and the site register-pressure.